Good Practice

Guide 154

Energy efficient refurbishment of public houses – heating and hot water

"Upgrading heating systems and controls can reduce running costs and lead to significant savings"

BEST PRACTICE PROGRAMME

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

BEST PRACTICE PROGRAMME

This Good Practice Guide is one of a series resulting from a joint initiative by the Brewers and Licensed Retailers Association, and BRECSU, which acts on behalf of the Department of the Environment's Energy Efficiency Office.

The aims are to identify measures to improve energy efficiency in public house refurbishment, and to offer guidance for their effective implementation. The Guides as a whole illustrate the importance of adopting an integrated approach to the energy efficient design of refurbishments in public houses, while each Guide deals with a particular aspect of refurbishment.

In addition to reducing costs and increasing competitiveness, energy efficiency measures can improve customer comfort and reduce the adverse impact on the environment caused by burning fossil fuels.

The series of Guides makes a contribution to further improving the industry's record in energy efficiency. It provides information which will enable brewers and designers to refurbish in an energy efficient way. Using all the Guides together, an integrated design approach to energy efficient refurbishment is possible, leading to reduced operating costs and increased profits. For example, an average energy cost reduction of 25% should be possible in the 13 500 managed houses, which consume around £100 million worth of energy each year, leading to an energy saving of around £25 million per year in due course.

Guides cover the following topics:

Building fabric	**GPG 150**
Ventilation	**GPG 151**
Lighting	**GPG 152**
Cellar services	**GPG 153**
Heating and hot water	**GPG 154**
Catering	**GPG 156**
Energy surveys	**GPG 157**

and are intended for:

- building surveyors and project managers
- architects and interior designers
- building contractors and services subcontractors

Introduction

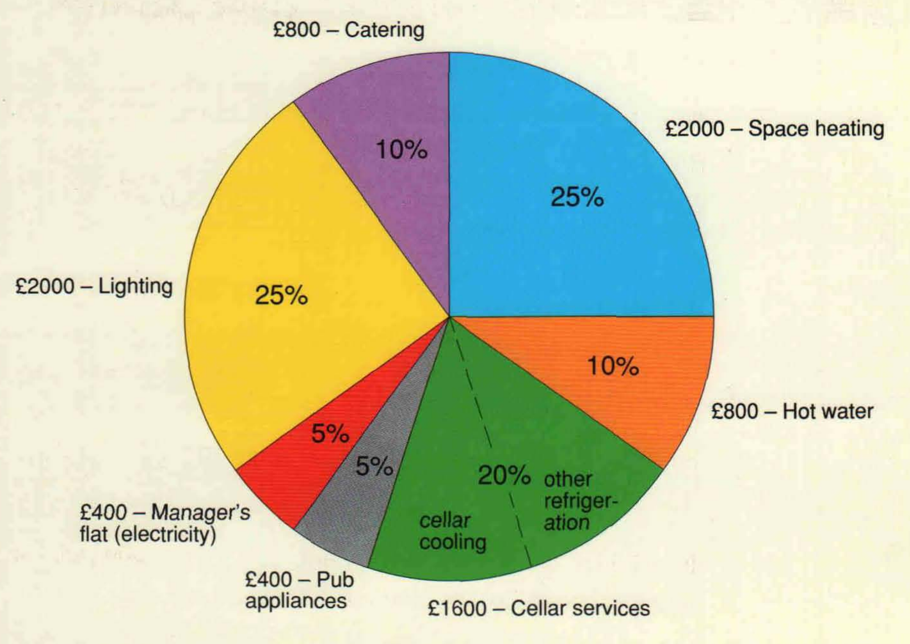
The energy bill for the 65 000 or so public houses in the UK is at present around £500 million per annum, ie for each public house an average bill of £8000 per annum. For a typical public house, the energy costs can be broken down as shown in figure 1.

However, when a public house is refurbished, energy costs often rise dramatically, often by 40% and sometimes by as much as 100% due to:

- better heating levels
- higher ventilation rates
- more attractive lighting
- increased catering.

Without a commitment to energy efficiency, brewers will be faced with escalating costs from successive refurbishments. The aim should be to provide the required level of customer service for minimum energy cost.

This Guide details the opportunities for improving energy efficiency when installing or upgrading heating and hot water systems in a public house.



Note: Space heating cost comprises roughly equal amounts for fabric losses and for ventilation losses

Figure 1 Typical distribution of energy costs in a public house

Energy use in heating and hot water services

Statutory requirements relating to heating and hot water services are specified in the Building Regulations, Part J[1] for heat producing appliances and Part L[2] for conservation of fuel and power. An integral package of plant, controls and layout will improve energy efficiency and minimise running costs.

Space heating and hot water supply usually account for 35% to 40% of the energy cost for a typical public house. With the rising costs of water supply, hot water consumption has taken on added importance.

Heating requirements

The capacity required of the heating system is dictated by the aggregated heat losses from:

- building fabric
- consumption of hot water
- uncontrolled air infiltration
- ventilation

but alleviated by incidental heat gains from:

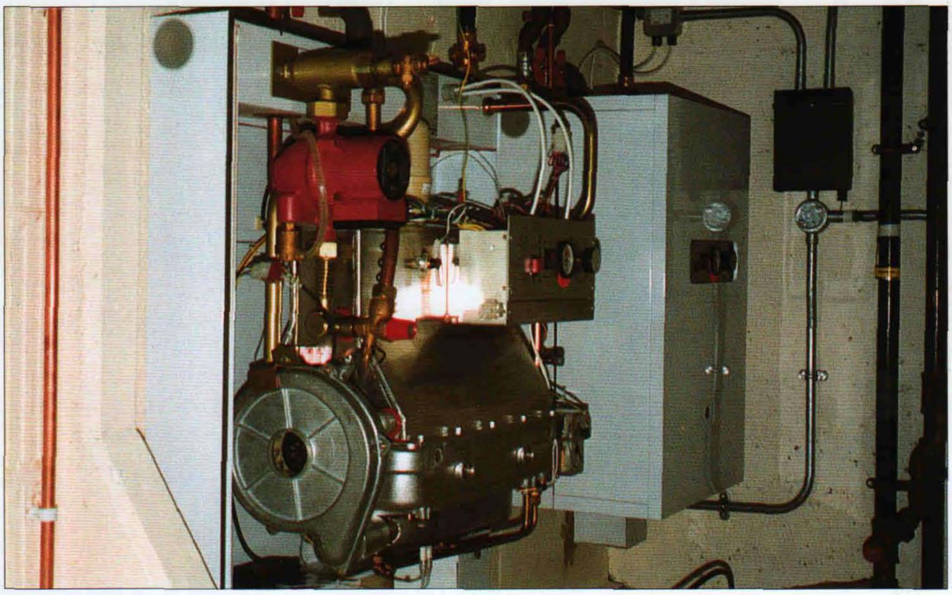
- lighting and appliances
- catering equipment
- cooling equipment
- occupants
- solar gains.

This is illustrated in figure 2.

Energy saving opportunities

The main opportunities for reducing space heating consumption are in:

- building fabric insulation
- space heating system and boiler selection
- distribution of hot water services
- operational control.



A condensing boiler can be a cost-effective replacement unit, with a higher operating efficiency than a conventional boiler

Fabric insulation

The type of construction and the position of the insulation will affect the way the building responds to the space heating system. A traditional building with heavy fabric will heat up more slowly than a modern insulated building with lightweight fabric. It will therefore require more time or more space heating plant capacity to achieve comfortable occupancy conditions. On the other hand, it will also retain warmth and provide comfortable occupancy conditions at slightly lower temperatures. Methods of improving the thermal performance of the building fabric are described in Good Practice Guide (GPG)150[3].

Heating system design

Fan convectors can provide rapid and effective distribution of heat with prompt response to controls. Their main disadvantages are the relatively high fuel costs and the limited amount of radiant heat, which results in little heat retention in the fabric. The high velocity of airflow can cause a feeling of draughtiness, and requires careful positioning of outlets. In addition, some types of heater can be obtrusively noisy.

Wet radiator systems provide an effective combination of radiant heat and convective heat supply.

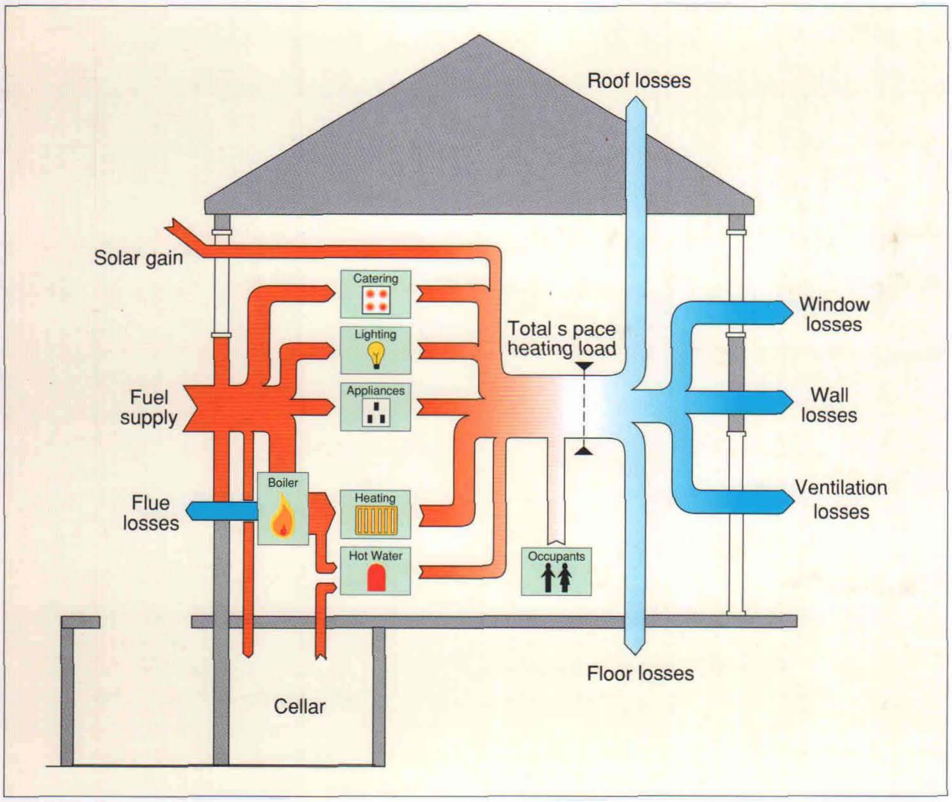


Figure 2 Space heating – gains and losses

The two main types of radiator are:

- panel radiators, fabricated from steel panels and fitted with fins to increase efficiency in heat distribution; they are comparatively lightweight and have a low water content, which enables them to respond quickly to controls
- column radiators with quick response to controls.

Older cast-iron radiators have a high thermal mass and are slow to respond to controls, which can result in overheating in mid- or late evening. The only effective solution is to use locally controlled, tamper-proof thermostatic radiator valves (TRVs).

Boxed radiators normally operate inefficiently because the free outlet area is often too small and this leads to an uneven distribution of warmth.

Less effective than radiators are finned tubes, which are traditionally fitted below the fixed seats in public houses. To achieve reasonable efficiency, ensure that:

- the air inlets in front of the seats are of adequate size and are not restricted; the total inlet area should be 1.5 to 2.0 times the plan area of the finned tubes
- adequate control is established, either as part of a zone heating system or by thermostatic radiator valves with remote sensor
- the inside surfaces of the walls below the seats are well insulated
- the total area of outlet vents is not less than that of the inlet vents
- warmed air can escape freely through the upper vents behind the seats. (See figure 3.)

All distribution pipework should be insulated, unless it is intended to serve as a heat emitter such as, for example, radiating pipes in toilets and stores. Heating pipes should preferably not be routed through exterior or unheated areas, and particularly not through the cellar, unless they are insulated.

A two-pipe distribution system should be used wherever possible. Single pipe systems are less energy efficient, as their slow response makes them difficult to control. They also require larger and more obtrusive pipework, and should be used only where unavoidable, eg where an existing system is to be extended.

Boiler plant

The choice of boiler plant should take into account the nature of the heating demand, ie to what extent it will be continuous or intermittent. In some cases there may be efficiency gains in installing, in addition to the boiler for the trade premises, a separate boiler to heat the manager's residence and provide the domestic hot water. It is important, however, to include in the cost considerations the extra servicing and maintenance associated with the installation of duplicate appliances.

Oil-fired boilers typically have an efficiency of approximately 77%. Conventional gas-fired boilers, as used in the majority of public houses, can have efficiencies of 75% to 85%, depending on type. Condensing boilers, with an operating efficiency of up to 90%, should be considered when replacing boilers. For a typical public house with a heating and hot water bill of over £2000, a condensing boiler can give an annual fuel saving of 15%, and pay for itself in 2 to 3 years.

Detailed guidance on the selection of condensing boilers is given in Green House Guide No 1[4] (relevant to small public houses) and GPG 16[5] (more relevant to large premises where the installed load for heating and hot water is above 30 kW).

Hot water supply

Hot water is usually provided from a central storage tank, heated from the main boiler. Where hot water is drawn intermittently over long distances, heat losses can occur from standing water in the distribution pipework. Separate direct gas-fired water heaters can

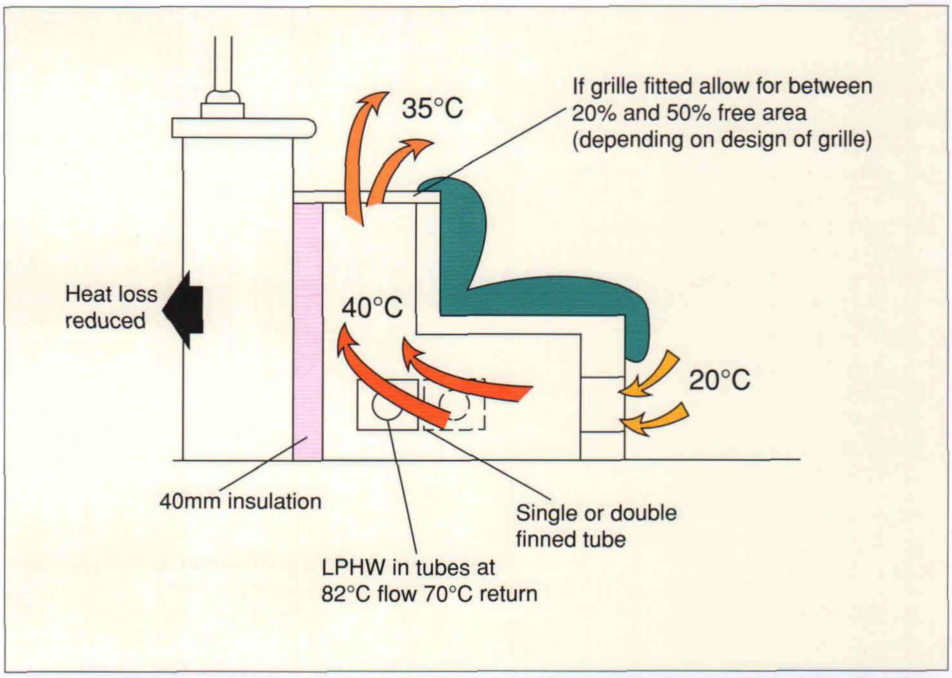


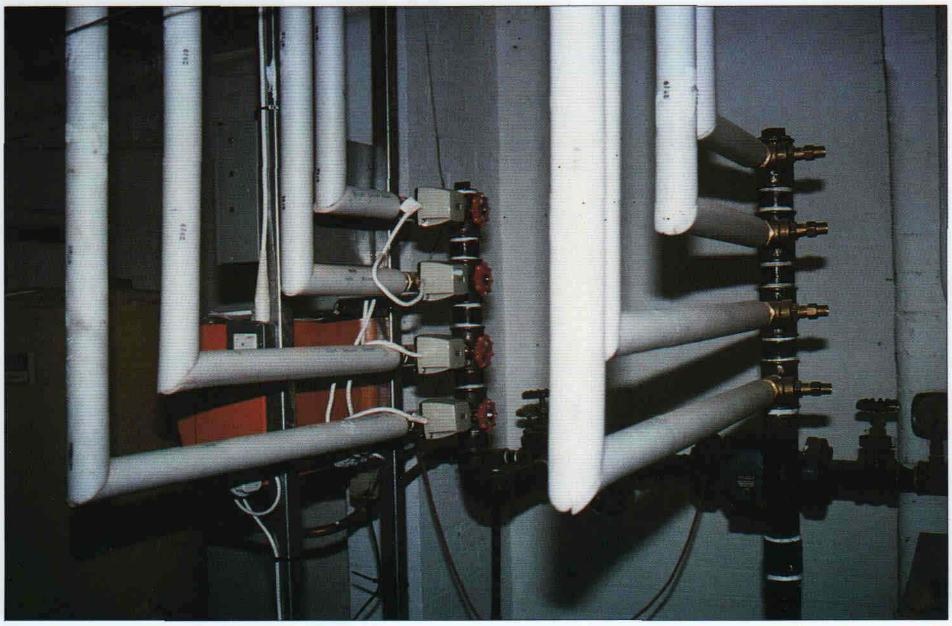
Figure 3 Cross-section of fixed seating against an outside wall showing finned tube heating

reduce such losses and allow the boiler to be shut down when no space heating is required.

In remote locations, instantaneous water heaters with timers may be an economical alternative to piped hot water supply. As is the case for boilers, wherever separate heating appliances are considered, the costs of maintaining multiple units should be taken into account.

Mixer taps with spray heads and timers can limit waste in changing rooms and toilets, although in hard water areas scaling can be a problem.

Controls
Control systems should be matched to the complexity of the heating system and the allocation of responsibility for the management of the system. Unless fully understood and conscientiously operated, there is a risk that controls remain incorrectly adjusted and unchecked for long periods, in which case the potential benefits of energy efficiency will not be realised.



This view inside a boiler house shows how heating zones were introduced as part of a refurbishment scheme. The orange controller attached to the rack support system separately controls heating to the manager's flat, function room, lounges and catering areas

The main types of automatic controls are:

- simple timeswitch
- simple electronic time controllers
- multi-zone electronic time controllers
- building energy management systems.

Simple timeswitch systems are initially inexpensive, although the installation of direct, hard wiring to each controller needs consideration when calculating costs. Electromechanical time switches can be fiddly to set up and adjust, and the adjustment is very coarse. Consequently, such time switches are often manually overridden.

Simple electronic time controllers are available with optimum start control. They can allow control of up to two different zones and therefore their use is mainly in smaller public houses.

Multi-zone electronic time controllers are microprocessor-based units, which can control a number of zones on separate programmes with optimum start on one zone. They can be self-tuning, which enables them to adjust according to the thermal characteristics of the building, and allow more accurate prediction of the optimum start-up time.

Where multi-zone electronic time controllers are selected, it is recommended that they should provide the following additional functions:

- weather compensation
- pump overrun
- frost protection
- condensation protection
- recording of optimum start settings (for checking controller operation).

Some versions will also provide individual control of emitters and other devices.

Building energy management systems (BEMS) use microprocessor-controlled units which provide all the required facilities in one 'box', and are now available at prices equal to or less than those for conventional controls.

A BEMS unit can monitor many separate channels with a clear indication of the state of each channel, and give early warning of problems. In addition, the standard of control is much higher than with conventional electromechanical controls, resulting in more efficient heating and lower fuel bills. With such a wide range of options, the user can specify exactly which functions are needed in each particular case.

Where BEMS are installed in several public houses under the same management, they can be controlled at a central management office for the whole public house estate.

Estate management systems have the following advantages:

- the system can report automatically to a central location at any distance via a normal telephone line
- the exact state of data collected can be read out at a central station
- a public house manager can be relieved of control tasks by a central station supervisor, but can retain the option of 'local control' adjustment if so desired
- the supervisor can call out maintenance personnel in the event of a fault, often before the manager is aware of it. The system can be programmed to control lighting and other switched devices as well as heating.

References

[1] The Building Regulations 1990. Part J: Heat Producing Appliances – Department of the Environment.

[2] The Building Regulations 1995. Part L: Conservation of Fuel and Power – Department of the Environment.

[3] Good Practice Guide 150: Energy efficient refurbishment of public houses – building fabric – EEO, 1995.

[4] Green House Guide No 1: Condensing boilers for housing – Department of the Environment, 1993.

[5] Good Practice Guide 16: Guide for installers of condensing boilers in commercial buildings – EEO, 1990.

[6] CIBSE Technical Memorandum 13: Minimising the risk of Legionnaires' Disease – Chartered Institution of Building Services Engineers.

[7] Good Practice Guide 153: Energy efficient refurbishment of public houses – cellar services – EEO, 1995.

Further reading

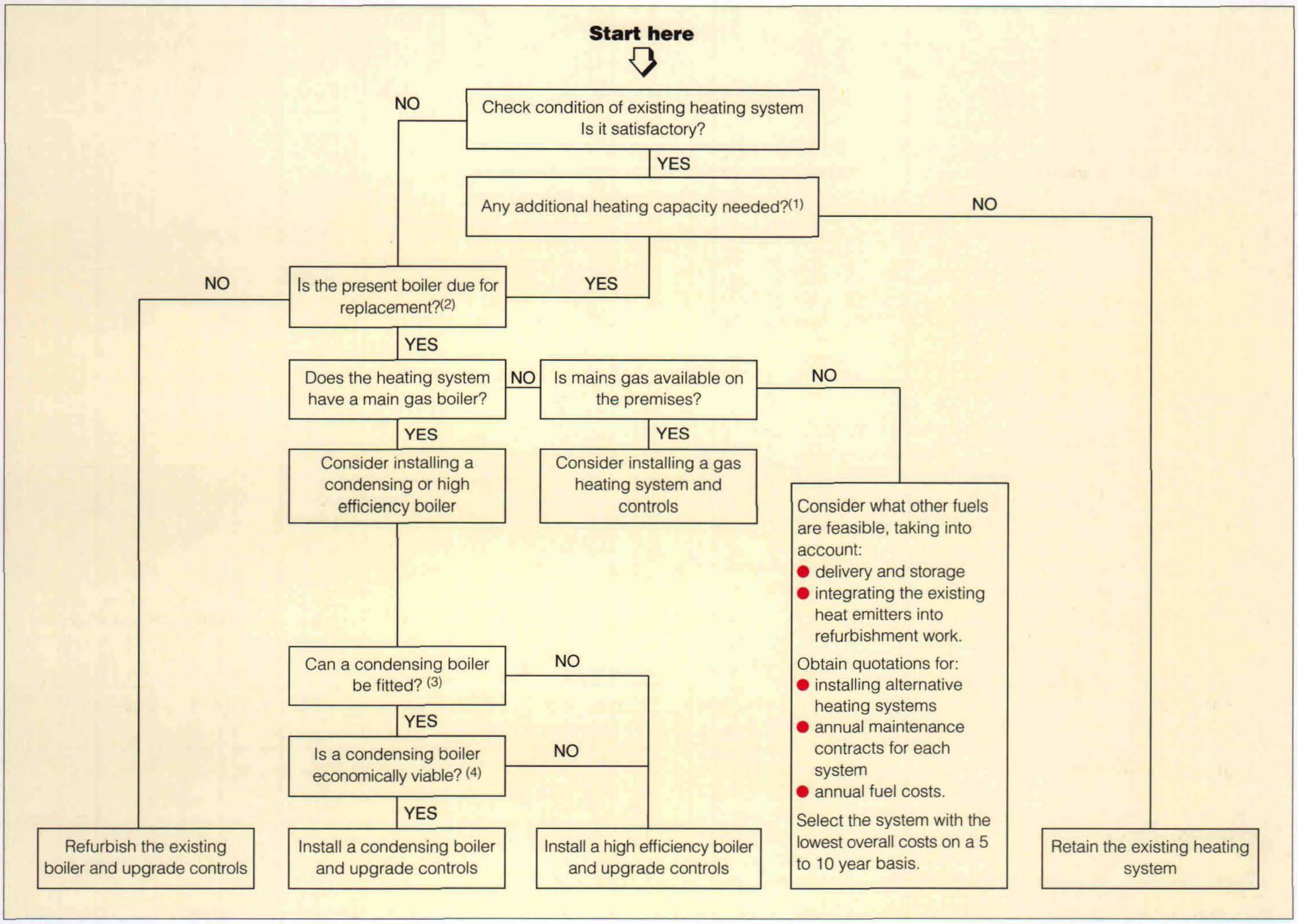
CIBSE AM3: Condensing boilers – Chartered Institution of Building Services Engineers, 1989.

Good Practice Guide 32: Condensing boilers: Applications manual – EEO, 1991.

Energy Consumption Guide 13: Energy efficiency in public houses – EEO, 1992.

Introduction to energy efficiency in catering establishments – EEO, 1994.

Technical data sheet A
Selection of heating systems



Notes:
1. If in a refurbishment the heating system is to be extended, the existing boiler may be too small to supply the extra heating. A new high efficiency or condensing boiler could be installed either to replace or to supplement the existing boiler.
2. Boiler life is 10 to 15 years. Boilers of this age and not in good condition could, with advantage, be replaced with a condensing or high efficiency boiler.
3. Check that the requirements in technical data sheet B can be met. If a condensing boiler is not viable, or if the requirements cannot be satisfied, then install a high efficiency conventional boiler.
4. Check the cost-effectiveness of a condensing boiler as discussed in the main text. If a condensing boiler is not viable, fit a high efficiency conventional boiler.

Technical data sheet B
Requirements for condensing boilers

When considering the installation of a condensing boiler use the checklist below to decide whether the installation and operating requirements can be satisfied (1).

Requirement	Design solution	Check
Boiler flue must be resistant to attack of wet, corrosive flue gases, self-draining and leak free.	Preferably use balanced flue. Use new flue or line existing flue (2).	Existing flue: ● type and condition ● route through building ● pressure drop in flue
Drain line required to take condensate from boiler and flue.	Standard PVC drainpipe with trap is adequate. Use deep seal trap if connected to drains.	Position of nearest drain/gully (3): ● in boiler room? ● nearby? ● is drain below level of boiler room?
Heating pump with high delivery pressure to overcome higher pressure drop through condensing boiler.	Check present pump performance. Fit new pump if required.	Is it possible to fit new pump in existing space?
Condensing boiler needs different inhibitor from standard boilers.	Fully drain existing system and refill with water and recommended inhibitor.	Does heating contractor know of the requirement? Is the system adequately labelled to ensure correct treatment in future?
Regulate temperature control on boiler to match heating demand and maximise condensing operation.	Fit outside temperature compensator to regulate boiler temperature.	Is the specified control suitable for the duty?
Steam plume from flue must not cause problems.	Locate flue away from problem areas.	Is existing flue position acceptable?

Notes: 1. Refer to boiler manufacturer's recommendations on all points.
2. Austenitic stainless steel flue or flue liner is usually adequate.
3. Drain or gully level must be below condensate drain outlets on boiler, or else a pump must be fitted.

Technical data sheet C
Measures to improve energy efficiency in hot water systems

Item	Measure
Hot water taps	Use local 'instant' water heaters where long runs of pipework are currently needed. Fit mixer spray taps. Fit timers to taps.
DHW storage cylinder	Do not oversize. Base design capacity on the difference between peak load and the maximum continuous output from the water heater. Purchase pre-insulated versions.
DHW temperature	Set the thermostat control to 60°C, to ensure that all parts of the system are kept above 55°C to avoid the risk of Legionnaires' Disease, see CIBSE Technical Memorandum 13 [6].
Storage tank insulation	Fit 50 mm (minimum) blanket. New tanks should be pre-insulated.
Pipework insulation	Insulate all pipework, valve bodies and other fittings, see GPG 153 [7].
Time control	DHW heating should be timed and controlled separately.
Glass and dishwashers	Use only 'hot fill' types that recycle hot water and ensure that DHW supply is adequate (electric heating is very expensive) BUT operating temperature should not exceed the detergent makers' recommended maximum, both to minimise heat losses and to avoid damage to glassware.

Technical data sheet D
Relative advantages of heating systems where no piped gas is available

	Electricity		Oil	LPG	Solid
	on-peak	off-peak			
Capital costs	low	low/medium	high	high	high
Fuel costs	very high	medium/high	low	high	medium
Maintenance of system	low	low	medium	medium	high
Heat emitters	fan or panel heaters	storage heaters	radiators, convectors or finned tube heaters	radiators, convectors or finned tube heaters	radiators, convectors or finned tube heaters
Delivery/storage	none	none	tank	tank vehicle access	vehicle access

For further copies of this or other Best Practice programme publications please contact BRECSU and ETSU. Printed in the UK for HMSO Dd. 8439855, 3/95, C50, 38938

For buildings-related projects: Enquiries Bureau, BRECSU, Building Research Establishment, Garston, Watford, WD2 7JR. Tel 01923 664258. Fax 01923 664787. E-mail brecsuenq@bre.co.uk

For industrial projects: Energy Efficiency Enquiries Bureau, ETSU, Harwell, Oxfordshire OX11 0RA. Tel 01235 436747. Telex 83135. Fax 01235 433066.